

EXHIBIT C

UNITED STATES DISTRICT COURT
SOUTHERN DISTRICT OF NEW YORK

IN RE VALE S.A.
SECURITIES LITIGATION

No. 1:15-cv-09539-GHW

SUPPLEMENTAL REBUTTAL EXPERT REPORT OF WALTER N. TOROUS, PH.D.

August 15, 2019

Table of Contents

I.	INTRODUCTION	1
A.	Qualifications.....	1
B.	Assignment	1
II.	SUMMARY OF OPINIONS	2
III.	DR. FINNERTY’S ANALYSIS CORROBORATES MY OPINION THAT DR. TABAK HAS NOT DEMONSTRATED THAT THE FIFTH <i>CAMMER</i> FACTOR IS SATISFIED	3
A.	Overview of Dr. Tabak’s Market Efficiency Analysis	4
B.	Dr. Tabak Has Not Properly Specified His Market Model.....	6
IV.	DR. FINNERTY’S ANALYSIS AND OPINIONS UNDERMINE DR. TABAK’S CONCLUSION THAT VALE ADRS TRADED IN AN EFFICIENT MARKET.....	11
A.	Description of Dr. Finnerty’s Damages Model.....	12
B.	Dr. Finnerty Undermines the Results of Dr. Tabak’s Event Study and Market Efficiency Conclusion	13
C.	Dr. Finnerty’s Own Event Study Reveals There is No Statistical Evidence to Support Dr. Tabak’s Market Efficiency Conclusion	15

I. INTRODUCTION

A. Qualifications

1. I previously submitted a rebuttal report on November 3, 2017 (“Class Certification Report”)¹ responding to the expert report of Dr. David Tabak dated September 14, 2017 (“Tabak Report”)² in which I outlined my qualifications in Section I.A. My complete curriculum vitae, which includes a list of my publications, is attached as **Appendix A** to this report. **Appendix B** lists my testimony in the past four years.

2. My hourly rate for time I spend on this matter is \$875 per hour. In addition, I receive compensation based on the professional fees of Analysis Group, Inc. (“Analysis Group”), a financial and economic consulting firm, which has provided research support under my direction and supervision. My fees and Analysis Group’s fees do not depend upon the opinions I form nor upon the outcome of this litigation.

B. Assignment

3. Dr. John Finnerty submitted an expert report in this matter on July 19, 2019 (“Finnerty Report”)³ in which he opines on loss causation and damages issues, including the appropriate design and implementation of an event study used to measure the abnormal returns of Vale’s ADRs during the proposed class period (“Proposed Class Period”) from May 8, 2014 to November 27, 2015.⁴ In light of the opinions offered by Dr. Finnerty, Gibson, Dunn & Crutcher LLP (“Counsel”), counsel for Defendants, has requested that I do the following:

¹ Rebuttal Expert Report of Walter N. Torous, Ph.D., November 3, 2017.

² Expert Report of David I. Tabak, Ph.D., September 14, 2017.

³ Expert Report of John D. Finnerty, Ph.D., July 19, 2019.

⁴ Tabak Report, ¶ 1; Finnerty Report, n.1.

- a. Review the opinions offered by Dr. Finnerty as they apply to the report filed by Plaintiffs' class certification expert, Dr. Tabak.
 - b. In particular, Counsel has asked me to evaluate whether Dr. Finnerty's analysis and opinions are consistent with Dr. Tabak's methodology, and whether Dr. Tabak's findings relating to market efficiency are supported by Dr. Finnerty's event study methodology.
4. In performing my research and analysis, I have relied upon the documents and data listed in **Appendix C** and/or cited in this report and exhibits. My work on this matter is ongoing, and I may review additional materials or conduct further analysis. I reserve the right to update, refine, or revise my opinions.

II. SUMMARY OF OPINIONS

5. Based on my review and analysis, I have reached the following conclusions:
 - a. Dr. Finnerty's opinions regarding the appropriate design and implementation of an event study undermine the analysis and conclusions offered by Plaintiffs' class certification expert, Dr. Tabak, that purportedly demonstrate that Vale ADRs traded in an efficient market.
 - b. As I opined in my Class Certification Report and as corroborated by Dr. Finnerty, the estimation period that Dr. Tabak utilized for his event study (one year prior to the Proposed Class Period) is not appropriate to draw inferences regarding the behavior of Vale ADRs during the Proposed Class Period.
 - The selection of an appropriate estimation period is important to ensure that reliable inferences can be drawn concerning the relationship between Vale ADRs and market- and/or industry-specific indices. In contradiction to Dr. Finnerty, Dr. Tabak failed to consider that the volatility of Vale ADRs was substantially elevated during the Proposed Class Period as compared to his chosen estimation period. Thus, Dr. Tabak's conclusions regarding the response of Vale ADR prices to material news, which are based on the volatility observed during Dr. Tabak's estimation period, are not reliable.
 - Consistent with the opinions that I presented in my Class Certification Report, Dr. Finnerty also finds that the estimation period that Dr. Tabak used for his event study is not appropriate to draw inferences regarding the behavior of Vale ADRs

during the Proposed Class Period and “will lead to biased test results” and model mis-specification.⁵

- c. When I adjust Dr. Tabak’s analysis of the fifth *Cammer* factor (i.e., whether a cause and effect relationship exists between the disclosure of new, material, company-specific news and Vale ADRs’ price) using Dr. Finnerty’s proposed event study specification (which accounts for the difference in volatility before and during the Proposed Class Period), I find no statistical evidence to support Dr. Tabak’s conclusion regarding the fifth *Cammer* factor. In other words, using the event study model put forward by Plaintiffs’ loss causation expert, Dr. Finnerty, invalidates Dr. Tabak’s conclusion that the “market for Vale’s Common [and Preferred] ADRs reacted differently on days with earnings announcements than on days without earnings announcements.”⁶
- d. Therefore, to the extent the Plaintiffs are relying on Dr. Tabak’s analysis to demonstrate that Vale ADRs traded in an efficient market, Dr. Finnerty’s analysis and opinions not only contradict Dr. Tabak’s findings, but also affirm the opinions in my Class Certification Report that Plaintiffs have not demonstrated that Vale ADRs traded in an efficient market.

III. DR. FINNERTY’S ANALYSIS CORROBORATES MY OPINION THAT DR. TABAK HAS NOT DEMONSTRATED THAT THE FIFTH *CAMMER* FACTOR IS SATISFIED

6. In the Tabak Report, Dr. Tabak opines that Vale ADRs traded in efficient markets, and, as a result, that damages can be calculated on a class-wide basis using a common methodology.⁷ Specifically, Dr. Tabak finds that “[t]he tests of stock price response to news, the *Cammer* factor that most directly tests market efficiency, provide strong evidence that Vale’s ADR prices responded to material new information” during the Proposed Class Period.⁸

⁵ Finnerty Report, ¶ 41.

⁶ Tabak Report, ¶ 38.

⁷ Tabak Report, ¶¶ 3, 59.

⁸ Tabak Report, ¶ 45.

7. To assess whether Vale ADRs traded in an efficient market, Dr. Tabak evaluates certain factors enumerated in *Cammer v. Bloom*, 711 F. Supp. 1264 (D.N.J. 1989) (i.e., the *Cammer* factors).⁹ The fifth *Cammer* factor, which Dr. Tabak states “most directly tests market efficiency,”¹⁰ examines “[w]hether a stock price responds to material, new unexpected information.”¹¹ As I described in my Class Certification Report and as corroborated by Dr. Finnerty’s analysis, Dr. Tabak’s analysis of the fifth *Cammer* factor suffers from several problems that render his conclusion regarding market efficiency unreliable. Of particular relevance to this report, the estimation period that Dr. Tabak utilized for his event study is not appropriate to draw inferences regarding the behavior of Vale ADRs during the Proposed Class Period because the volatility of Vale ADRs was substantially elevated during the Proposed Class Period relative to Dr. Tabak’s estimation period.

A. Overview of Dr. Tabak’s Market Efficiency Analysis

8. To evaluate whether there exists a cause and effect relationship between a company’s disclosures and the resulting stock price movements (i.e., the fifth *Cammer* factor), Dr. Tabak performs an event study. An event study is a statistical method widely used by economists to infer the stock price reaction to a specific disclosure (or event). On a given day, the price of a publicly-traded stock is impacted by a wide range of information, including market- and/or industry-specific factors, as well as company-specific news. When designed and implemented correctly, an event study can be used to isolate the part of the price movement that may be attributable to a specific disclosure or event.

⁹ Tabak Report, ¶¶ 13–16.

¹⁰ Tabak Report, ¶ 45.

¹¹ Tabak Report, ¶ 31.

9. To perform his event study, Dr. Tabak first separates the Proposed Class Period into “news days” and “non-news days.”¹² He then constructs a market model, using the S&P ADR Total Return Index to control for the market trend,¹³ to test the number of days among all “news days” on which Vale ADRs experienced a statistically significant price movement. He performs the same analysis for the “non-news days.”¹⁴ Finally, he compares the percentage of “news days” on which Vale ADRs had a statistically significant price change to the percentage of “non-news days” on which Vale ADRs had a statistically significant price change to determine whether the *difference* in these percentages is itself statistically significant.¹⁵ If the difference in those percentages is statistically significant, he concludes that there was a cause and effect relationship between the company’s disclosures and the resulting stock price movements, and that the fifth *Cammer* factor was satisfied.¹⁶

10. Dr. Tabak performs this comparison using three scenarios, which differ with respect to the criteria he uses to categorize “news days” and “non-news days.”¹⁷ In the first scenario (“Earnings Dates”), he defines “news days” as days when Vale released earnings. In the second

¹² Tabak Report, ¶¶ 33, 35.

¹³ Tabak Report, ¶ 37.

¹⁴ Tabak Report, ¶ 36.

¹⁵ Tabak Report, ¶ 36.

¹⁶ Dr. Tabak determines whether the difference in the percentages was statistically significant by performing a z-test, a common method in statistical hypothesis testing. A z-statistic (also known as a z-score) represents the number of standard deviations that a specific value is from the population mean. An absolute value of a z-statistic of 1.96 or higher would indicate statistical significance with at least 95 percent confidence, and thereby would suggest that Vale ADRs experienced statistically different price movements on “news” days when compared to “non-news” days. *See, e.g.,* Paul Newbold, et al., *Statistics for Business and Economics*, 8th Edition, Pearson (2012), p. 57 and Standard Normal Distribution Table. The 95 percent confidence level is the same one used by Dr. Tabak in his fifth *Cammer* factor analysis. *See* Tabak Report, Exhibits 8a1 and 8a2.

¹⁷ Tabak Report, ¶ 35.

scenario (“*Dow Jones Newswires* – All Sources”), he defines “news days” as days when *Dow Jones Newswires* published news stories with “Vale” in the headline or the lead paragraph. In the third scenario (“*Dow Jones Newswires* – Excluding Selected Articles”), Dr. Tabak begins with the set of “news days” he identified in the second scenario and then excludes articles that he deemed to be non-material.¹⁸

11. Under all three scenarios, Dr. Tabak concludes that the difference between the percentage of “news days” and “non-news days” that experienced abnormal returns is statistically significant at the five percent significance level.¹⁹ He thus concludes that “[t]he tests of stock price response to news, the *Cammer* factor that most directly tests market efficiency, provide strong evidence that Vale’s ADR prices responded to material new information.”²⁰

B. Dr. Tabak Has Not Properly Specified His Market Model

12. Dr. Tabak’s market model suffers from several conceptual flaws, which I articulate in my Class Certification Report and which are corroborated in the Finnerty Report. Among these, the estimation period that Dr. Tabak utilized for his event study—which is the focus of this report in light of the opinions put forth by Dr. Finnerty—is not appropriate to draw inferences regarding the behavior of Vale ADRs during the Proposed Class Period.²¹

¹⁸ Tabak Report, ¶ 35.

¹⁹ Tabak Report, ¶¶ 38, 40, 41.

²⁰ Tabak Report, ¶ 45.

²¹ As described in my Class Certification Report, Dr. Tabak’s analysis of the fifth *Cammer* factor suffers from at least two other flaws that render his conclusion regarding market efficiency unreliable: (1) Dr. Tabak has not verified the news content and whether the abnormal returns detected by his market model are directionally consistent with the news on that day; (2) Dr. Tabak’s market model does not account for industry-specific factors during the Proposed Class Period. *See, e.g.*, Class Certification Report, ¶ 20.

13. When designed and implemented correctly, an event study can measure the “normal” relationship between a security (i.e., Vale ADRs in this case) and market and/or industry factors in order to infer the portion of the security’s price movements that are potentially attributable to company-specific news. In Dr. Tabak’s analysis, the “normal” relationship he is seeking to establish should reflect the relationship between Vale ADRs and market and/or industry indices that would exist absent the alleged fraud. Thus, the estimation period should be selected to ensure that this appropriate relationship can be established between Vale ADRs and indices so that reliable inferences can be drawn.

14. In particular, in selecting the one year prior to the Proposed Class Period as his estimation period, Dr. Tabak fails to consider that the volatility of Vale ADRs was substantially elevated during the Proposed Class Period. Dr. Tabak performed an Ordinary Least Squares (“OLS”) regression analysis to estimate the relationship between the daily returns of Vale ADRs and the daily returns of S&P ADR Total Return Index from May 8, 2013 through May 7, 2014 (or, Dr. Tabak’s “estimation period”).²² As an initial matter, Dr. Tabak does not explain his rationale for selecting this estimation period. In addition, his estimation period is not appropriate because Vale ADRs became more volatile during the Proposed Class Period relative to his estimation period (see **Exhibit 1**). This is corroborated by Dr. Finnerty, who writes that “Vale ADRs exhibited unusually heightened volatility during the Proposed Class Period.”²³ In fact, Dr. Finnerty specifically finds that “the price volatility of the Vale ADRs during the Proposed

²² Tabak Report, Exhibits 8b1 and 8b2.

²³ Finnerty Report, ¶ 40. *See also* Finnerty Report, Exhibits 4 and 5.

Class Period was approximately fifty percent higher than the volatility during the one-year period immediately preceding the Proposed Class Period.”²⁴

15. As I discussed in my Class Certification Report, using a low volatility estimation period to estimate the market model and then using the results of that market model to detect abnormal returns in a high volatility period may lead to unreliable inferences. That is, the lower volatility in Dr. Tabak’s estimation period will result in predicting a narrower range of price movements for Vale ADRs in the absence of any company-specific news than what actually occurred during the Proposed Class Period.²⁵ Using such a market model may lead to finding a greater number of days with abnormal (or excess) returns, leading to unreliable inferences that the excess returns were attributable to company-specific news.²⁶

16. Unlike the Finnerty Report, Dr. Tabak’s expert report does not address this change in Vale ADRs’ volatility and the impact on his event study results. In fact, he testified that he did

²⁴ Finnerty Report, ¶ 40.

²⁵ Specifically, the abnormal return of a security represents the deviation of the security’s actual return from the security’s predicted return based on a regression model. The abnormal return can be greater or less than zero due to chance alone. Therefore, to gauge if the abnormal return is sufficiently large (or outside its normal bounds), it is compared to the variability observed during the estimation period. However, if the variability of abnormal returns is elevated during the Proposed Class Period relative to the estimation period, then even abnormal returns within the bounds of its contemporaneous elevated variability would be deemed statistically significant if judged relative to the (lower) variability observed over the estimation period.

²⁶ I analyzed this mis-specification issue in my paper titled “Investigating Security-Price Performance in the Presence of Event-Date Uncertainty,” in which I found that “errors of inference may result if a researcher assumes no increase in variance around an event when variance actually increases. Intuitively, the researcher may erroneously interpret actual changes in variance as evidence of security price performance. By incorporating the possibility of increases in variance around events, our method provides a more accurate assessment of security performance.” Clifford Ball and Walter Torous, “Investigating Security-Price Performance in the Presence of Event-Date Uncertainty,” *Journal of Financial Economics*, Vol. 22 (April 1998), pp. 123–153, at p. 124.

not analyze the volatility of Vale ADRs when constructing his event study,²⁷ despite acknowledging that “changes in volatility could also affect price movements.”²⁸ In particular, he stated that volatility is “an input into the measure of statistical significance”²⁹ because, “if a market is more volatile, it takes a larger price movement to reach the level of statistical significance.”³⁰ Even though he agrees volatility affects the measure of statistical significance, Dr. Tabak, in contradiction to Dr. Finnerty, made no attempt to analyze differences in volatility between his estimation period and the Proposed Class Period.

17. It appears that the heightened volatility of Vale ADRs may have been partially a result of uncertainty and the gradual decline of iron ore prices throughout the Proposed Class Period. As one of the largest iron ore mining companies in the world and with iron ore accounting for a large portion of Vale’s revenue,³¹ Vale’s financial performance is impacted by the price of iron ore. Specifically, as shown in **Exhibit 2**, the performance of Vale ADRs closely tracked the price of iron ore during the Proposed Class Period. In fact, Vale provides a graph of historical iron ore prices as well as the spot price of iron ore on its website in its discussion of its iron ore business.³² Even Dr. Tabak agreed it was “likely” that the price of iron ore affected the price of Vale ADRs.³³

²⁷ Deposition of David I. Tabak, October 26, 2017 (“Tabak Deposition”), p. 166.

²⁸ Tabak Deposition, p. 182.

²⁹ Tabak Deposition, p. 205.

³⁰ Tabak Deposition, pp. 205–206.

³¹ US Securities and Exchange Commission, Form 20-F for Vale S.A., December 31, 2016, p. 17.

³² Vale, Iron Ore Indices, available at: <http://www.vale.com/EN/business/mining/iron-ore-pellets/Pages/Iron-Ore-Indices.aspx>.

³³ Tabak Deposition, p. 212.

18. In addition, throughout the Proposed Class Period, analysts commonly cited declines in the price of iron ore, which are unrelated to the allegations in this case, as an important factor in Vale's financial performance. For example, in May 2014 (i.e., at the beginning of the Proposed Class Period), Scotiabank analysts wrote that "Vale's NAV sensitivity to nickel [is] relevant but clearly dwarfed by iron ore."³⁴ They estimated that a five percent decline in iron ore price (approximately \$5.00 per ton) would decrease Vale's EBITDA by \$1.5 billion. The analysts further concluded that "Vale's exposure to iron ore will likely remain much higher, suggesting the market's uncertainty regarding oversupply and Chinese demand will remain an overhang on the share price."³⁵ Another analyst wrote in May 2014 that "the stage is set for falling iron ore prices," which would be "bad news for Vale."³⁶ Similarly, in June 2015, J.P. Morgan stated, "We remain Neutral on Vale shares as we believe iron ore prices will come under pressure in 2H15," and that "the overall business environment has deteriorated faster and sharper than we anticipated," specifically referencing changes in iron ore prices.³⁷ Even after the Fundão Dam (the "Dam") collapse, analysts noted that volatility in the price of Vale ADRs was expected to continue, citing the effect of iron ore prices on Vale: Credit Suisse noted in November 2015 that "the stock price has moved up or down by 20% or more in a month in at least 8 of the past 24 months or the analyst expects significant volatility going forward;"³⁸ Morningstar commented that "[w]e assign a very high uncertainty rating to Vale primarily because of the company's

³⁴ Scotiabank, "Vale SA, Nickel Optimism or Iron Ore Realism?" May 16, 2014, p. 3.

³⁵ Scotiabank, "Vale SA, Nickel Optimism or Iron Ore Realism?" May 16, 2014, p. 2.

³⁶ Morningstar Equity Research, "Vale SA, Vale's low costs and ample growth prospects partly offset waning Chinese iron ore appetite," May 1, 2014, p. 1.

³⁷ J.P. Morgan, "Vale – Weak Commodity Price Outlook to Keep Pressure on FCF; Stay Neutral," June 29, 2015, pp. 1, 8.

³⁸ Credit Suisse, "Vale," November 23, 2015, p. 14.

sensitivity to iron ore prices, which drives nearly all of the firm's profits."³⁹ Thus, uncertainty and declining iron ore prices throughout the Proposed Class Period contributed to volatility in the prices of Vale ADRs throughout the Proposed Class Period.

19. Given the increase in volatility of Vale ADRs during the Proposed Class Period identified in both my Class Certification Report and the Finnerty Report, Dr. Tabak's market efficiency event study is based on an estimation period that does not appropriately establish the relationship between Vale ADRs and his market index. For this reason alone (notwithstanding the other flaws I identified in my Class Certification Report), his event study results are unreliable and cannot, with accuracy, reliably establish whether a statistically significant abnormal return was a reaction to a Vale-specific information disclosure or whether it was found to be statistically significant due to a failure to properly control for industry effects or for the difference in the volatility of Vale ADRs during the estimation period and the Proposed Class Period. Hence, Dr. Tabak has not proven that the fifth *Cammer* factor is satisfied.

IV. DR. FINNERTY'S ANALYSIS AND OPINIONS UNDERMINE DR. TABAK'S CONCLUSION THAT VALE ADRS TRADED IN AN EFFICIENT MARKET

20. Dr. Finnerty was instructed to assume market efficiency for purposes of his loss causation and damages analysis.⁴⁰ While Dr. Finnerty states that he does not offer any opinions regarding market efficiency in his report,⁴¹ Dr. Finnerty's own opinions regarding the appropriate design and implementation of an event study undermine Dr. Tabak's analysis that purportedly demonstrates that Vale ADRs traded in an efficient market.

³⁹ Morningstar Equity Research, "Vale SA, Vale generates profits even given the decline in iron ore prices, due to its low-cost production," November 24, 2015, p. 2.

⁴⁰ Finnerty Report, n.2.

⁴¹ Finnerty Report, n.2.

21. To demonstrate the unreliability of Dr. Tabak's analysis, I perform Dr. Tabak's comparison of the percentages of statistically significant "news" and "non-news" days but using the event study model developed by Dr. Finnerty to identify the days that experienced statistically significant abnormal returns.⁴² I find that the difference in the percentages is no longer statistically significant. In other words, if Plaintiffs' loss causation expert's event study model (which better accounts for heightened volatility) is substituted in Dr. Tabak's analysis, the results no longer support Dr. Tabak's opinions that a cause and effect relationship existed between the company's disclosures and the resulting stock price movements.

A. Description of Dr. Finnerty's Damages Model

22. To support his opinions regarding loss causation and damages, Dr. Finnerty performs an event study.⁴³ As described above, an event study is a statistical method used by economists to characterize and remove certain market and/or industry-specific factors from the price movements of a particular security.

23. In his event study, Dr. Finnerty applies a modified version of the Fama-French Three-Factor Model to calculate the expected returns of Vale ADRs.⁴⁴ Dr. Finnerty's "Modified Fama-French Three-Factor Model" adds three additional variables to the Fama-French Three-Factor

⁴² In using the event study model developed by Dr. Finnerty, I rely on the same data that Dr. Finnerty used in his model and that were produced as part of his supporting materials.

⁴³ Finnerty Report, ¶¶ 29–32.

⁴⁴ Finnerty Report, ¶ 34. The Fama-French Three-Factor Model expresses the excess return of a security on a particular date using three explanatory factors: (1) *market risk premium*, or the excess return of the U.S. equity market over the risk-free rate; (2) "*small minus big*," or the difference between returns on small-capitalization stocks and the returns on large-capitalization stocks; and (3) "*high minus low*," or the difference between the returns of "value stocks" and the returns of "growth stocks." Eugene F. Fama and Kenneth R. French, "Common risk factors in the returns on stocks and bonds," *Journal of Financial Economics*, Vol. 33 (1993), pp. 3–56; Finnerty Report, ¶ 34.

Model: (1) what he refers to as the “*industry return*,” or the return of the S&P Metals and Mining Select Total Return Index;⁴⁵ (2) “*Brazil equity market return*,” or the return of the Bovespa Index;⁴⁶ and (3) “*Brazilian Real / U.S. Dollar*,” or the daily percentage change of the Brazilian Real / U.S. Dollar foreign exchange rate.⁴⁷

24. Dr. Finnerty estimates abnormal returns to Vale ADRs based on his Modified Fama-French Three-Factor Model using the Proposed Class Period as the estimation period, excluding the dates of the alleged misrepresentations and corrective disclosures.⁴⁸ Within his estimation period, Dr. Finnerty introduces a structural breakpoint on May 12, 2015, resulting in two sub-periods within the Proposed Class Period.⁴⁹ Accordingly, Dr. Finnerty estimates two sets of regression coefficients for his explanatory factors (one for each sub-period).

B. Dr. Finnerty Undermines the Results of Dr. Tabak’s Event Study and Market Efficiency Conclusion

25. As I describe above and in my Class Certification Report, an event study’s estimation period must be appropriately chosen in order “to ensure that the appropriate relationship can be established between Vale ADRs and indices such that the correct inferences can be drawn.”⁵⁰

However, as described above, during Dr. Tabak’s estimation period of one year prior to the

⁴⁵ Finnerty Report, ¶ 43.

⁴⁶ Finnerty Report, ¶ 43. The Bovespa index is the benchmark for the B3 Brazilian market on which Vale is listed. “Bovespa Index (Ibovespa),” B3, available at: http://www.b3.com.br/en_us/market-data-and-indices/indices/broad-indices/ibovespa.htm; *see also* VALE3, Bloomberg, available at: <https://www.bloomberg.com/quote/VALE3:BZ>.

⁴⁷ Finnerty Report, ¶ 43.

⁴⁸ Finnerty Report, ¶¶ 40, 42.

⁴⁹ Finnerty Report, ¶¶ 45–46.

⁵⁰ Class Certification Report, ¶ 30.

Proposed Class Period,⁵¹ the price volatility of Vale’s ADRs was substantially lower than the price volatility during the Proposed Class Period (*see Exhibit 1*; Finnerty Report, Exhibits 4 and 5).

26. Consistent with the opinions I set forth in my Class Certification Report, Dr. Finnerty concurs that it is inappropriate to use an estimation period of one year prior to the Proposed Class Period to predict returns of Vale ADRs during the Proposed Class Period due to differences in volatility of Vale ADRs during the two periods.⁵² Specifically, Dr. Finnerty asserts, “[c]onsequently, it is my opinion that due to the substantially elevated volatility [of Vale ADRs] during the Proposed Class Period, it is more appropriate to use the Proposed Class Period than the one-year period prior to the Class Period as the estimation period for fitting the stock price model.”⁵³ He further opines, “[u]sing the Proposed Class Period as the estimation period provides a better fit for the purpose of estimating the Vale ADR abnormal returns during the Proposed Class Period.”⁵⁴

27. Importantly, Dr. Finnerty recognizes that using an inappropriate estimation period that is not representative of Vale’s ADR price volatility during the Proposed Class Period—as Dr. Tabak did in using one year prior to the Proposed Class Period as his estimation period—can lead to model mis-specification and “biased” results. Dr. Finnerty states:

The elevated volatility can cause the hypothesis tests using standard event study procedures to become *mis-specified* if the one-year period prior to the Proposed Class Period is used as the estimation period. When there is a

⁵¹ Tabak Report, Exhibits 8b1 and 8b2.

⁵² Finnerty Report, ¶ 40.

⁵³ Finnerty Report, ¶ 40.

⁵⁴ Finnerty Report, ¶ 41.

substantial increase in the variance of the security's returns during the event window, using a non-event estimation period to estimate the variance during the event period *will lead to biased test results* because the variance will be understated. This bias will result in excessive rejections of the null hypothesis that the excess return is equal to zero.⁵⁵

28. In other words, failing to use a correct estimation period can increase the probability of what statisticians call a Type I error (or a false positive) in which the event study finds statistical significance when a properly specified model would not. Dr. Finnerty's opinions therefore undermine not only Dr. Tabak's event study results (which, based on Dr. Finnerty's opinions, are "biased" due to the difference in Vale ADR price volatilities during and before the Proposed Class Period), but also Dr. Tabak's market efficiency conclusions that rely on those biased event study results.

C. Dr. Finnerty's Own Event Study Reveals There is No Statistical Evidence to Support Dr. Tabak's Market Efficiency Conclusion

29. The bias introduced by Dr. Tabak's choice of estimation period can be demonstrated by performing Dr. Tabak's fifth *Cammer* factor analysis using Dr. Finnerty's event study model. **Exhibits 3A and 3B** provide the results of my application of Dr. Finnerty's Modified Fama-French Three-Factor Model using the Proposed Class Period as the estimation period to Dr. Tabak's fifth *Cammer* factor analysis in which he compared the percentage of "news" and "non-news" days with statistically significant excess returns.

30. As shown, using Dr. Finnerty's event study methodology, the percentage of "news" days exhibiting statistically significant excess returns ranges from 0.0 percent to 6.9 percent (depending on which of Dr. Tabak's definitions of "news" is used) for both Vale's common and preferred ADRs. In contrast, the percentage of "non-news" days exhibiting statistically

⁵⁵ Finnerty Report, ¶ 41 (emphases added).

significant excess returns ranges from 4.4 percent to 5.3 percent for Vale's common ADRs and 4.0 percent to 5.0 percent for Vale's preferred ADRs (depending on which of Dr. Tabak's definitions of "news" is used). If I then calculate whether these two percentages are statistically significantly different from each other using a z-test (in accordance with Dr. Tabak's own methodology), the resulting z-statistic ranges from -0.58 to 0.98 shown in **Exhibit 3A** and -0.56 to 1.17 shown in **Exhibit 3B**.⁵⁶ As noted above, the z-statistic measures the probability that the calculated difference between "news" and "non-news" days, assuming price movements on "news" and "non-news" days were indistinguishable, could have occurred by chance. An absolute value of a z-statistic of 1.96 or higher would indicate statistical significance with at least 95 percent confidence, and thereby would indicate that there was a statistically significant difference in the price movements of Vale's ADRs on "news" days as compared to "non-news" days. More simply, if the absolute value of the z-statistic is 1.96 or higher, then Dr. Tabak would conclude that there was a cause and effect relationship between the company's disclosures and the resulting stock price movements and that the fifth *Cammer* factor is satisfied.

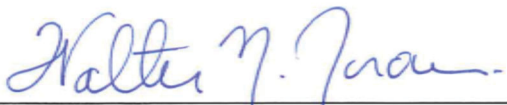
31. As shown in **Exhibits 3A and 3B**, the absolute value of all of the z-statistics is less than 1.96, meaning that Plaintiffs have not demonstrated that there was a statistically significant difference between price movements on "news" days and the price movements on "non-news" days. In short, when Dr. Tabak's model is adjusted using Dr. Finnerty's proposed specification to account for the difference in volatility during and before the Proposed Class Period, Dr. Tabak's conclusions reverse: the difference in percentages of "news" and "non-news" days that exhibited a statistically significant price reaction in Dr. Tabak's analysis is *not* statistically

⁵⁶ A z-statistic (also known as a z-score) represents the number of standard deviations that a specific value is from the population mean.

significant. That is, Dr. Tabak has not demonstrated that price of Vale ADRs reacted differently on “news” days as compared to “non-news” days. Therefore, there is no longer statistical evidence to support Dr. Tabak’s conclusion regarding the fifth *Cammer* factor “showing that the market for Vale’s Common ADRs reacted differently on days with earnings announcements than on days without earnings announcements.”⁵⁷

32. Dr. Finnerty’s opinions and analyses regarding how to perform an event study for Vale’s ADRs therefore support my own conclusions regarding Dr. Tabak’s event study. In the absence of demonstrating a cause and effect relationship between material, company-specific news and movements in Vale ADRs’ price, Dr. Tabak’s conclusions regarding market efficiency lack a statistical foundation. Given that the Plaintiffs rely on Dr. Tabak’s analysis to demonstrate that Vale ADRs traded in an efficient market, Dr. Finnerty’s opinions affirm the opinions in my Class Certification Report that the Plaintiffs have not demonstrated that Vale ADRs traded in an efficient market.

Executed on August 15, 2019

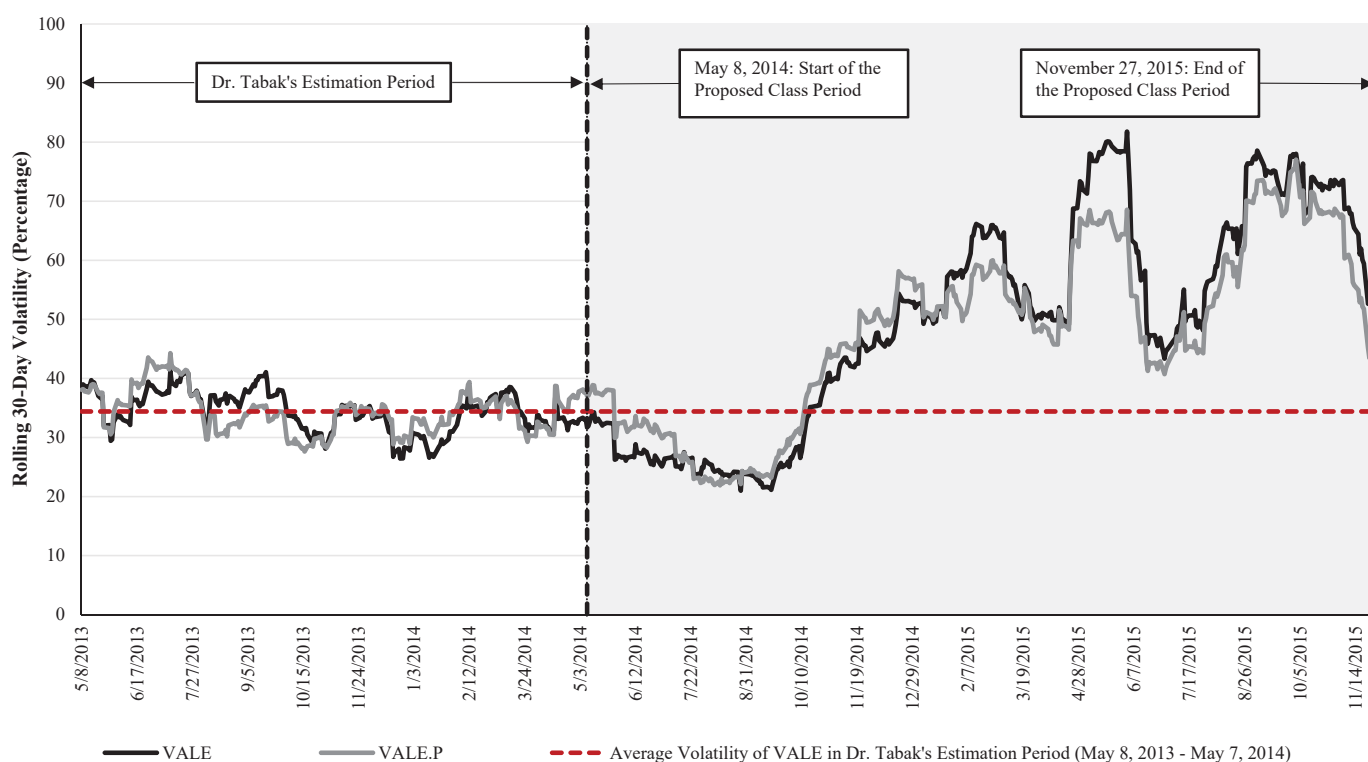


Walter N. Torous, Ph.D.

⁵⁷ Tabak Report, ¶ 38.

Confidential

Exhibit 1
Comparison of Rolling 30-Day Volatility of NYSE VALE and VALE.P
In Dr. Tabak's Estimation Period and the Proposed Class Period
May 8, 2013 to November 27, 2015

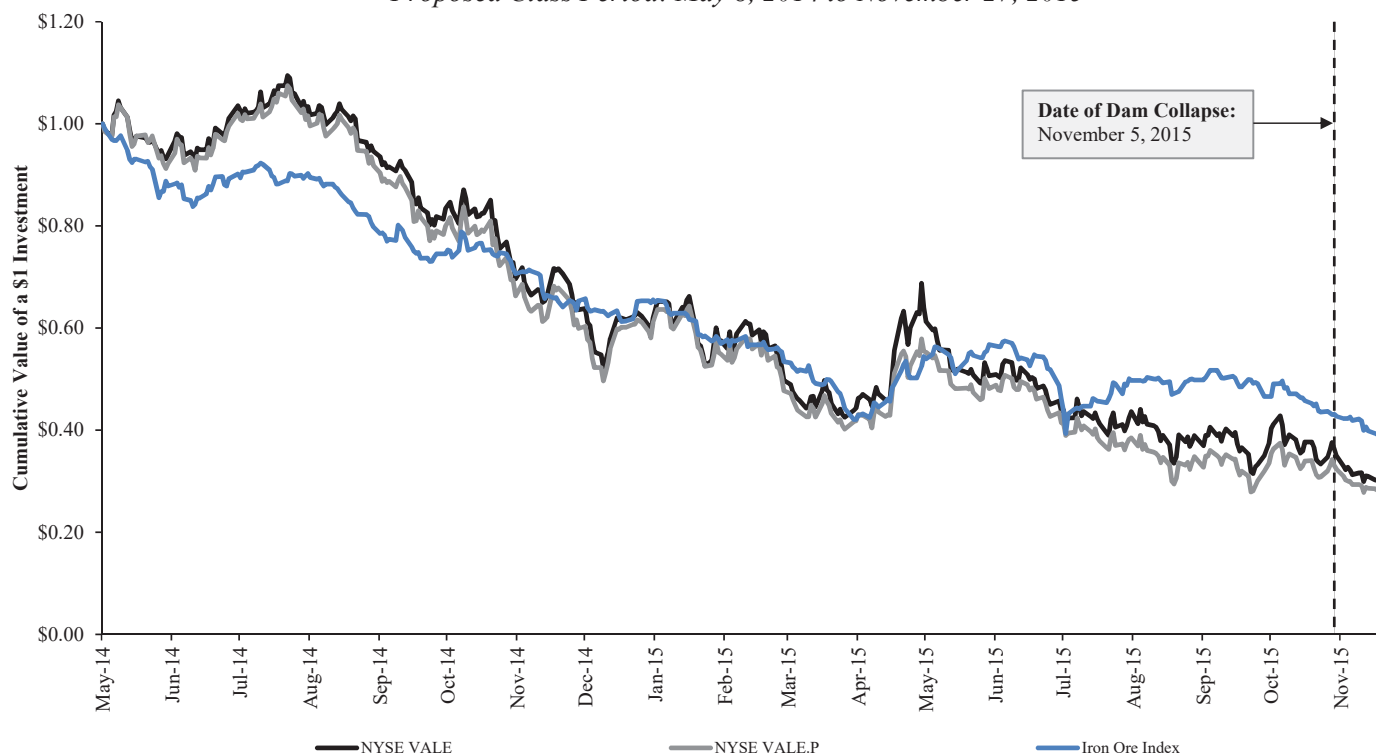
**Note:**

[1] The Rolling 30-Day Volatility equals the annualized standard deviation of the relative logarithmic price change for the 30 most recent trading days expressed as a percentage as reported by Bloomberg.

Sources: Bloomberg; Tabak Report.

Confidential

Exhibit 2
Cumulative Value of a \$1 Investment in the Vale ADRs Compared to the Iron Ore Index
Proposed Class Period: May 8, 2014 to November 27, 2015

**Notes:**

[1] NYSE VALE and VALE.P price adjusted for stock splits and dividends as reported by S&P Capital IQ.

[2] The Iron Ore Index as shown reflects the performance of the MB 62% Fe index, the benchmark index for iron ore according to Vale's website.

Sources:

S&P Capital IQ; Bloomberg; Complaint; Vale. S.A. website, "Iron Ore Indices," available at: <http://www.vale.com/EN/business/mining/iron-ore-pellets/Pages/Iron-Ore-Indices.aspx>.

Confidential

Exhibit 3A
Percentage of Dates with Statistically Significant Abnormal Returns on News Dates as Compared to Non-News Dates for NYSE VALE
Using Dr. Finnerty's Modified Fama-French Three-Factor Model
Proposed Class Period: May 8, 2014 to November 27, 2015

	News Dates			Non-News Dates			Difference in Percentages	z-Statistic	p-value
	Total Number	Number with Significant Excess Returns	Percentage of Dates with Significant Excess Returns	Total Number	Number with Significant Excess Returns	Percentage of Dates with Significant Excess Returns			
Earnings Dates	6	0	0.0%	358	19	5.3%	-5.3%	-0.580	0.562
<i>Dow Jones Newswires - All Sources</i>	116	8	6.9%	248	11	4.4%	2.5%	0.984	0.325
<i>Dow Jones Newswires - Excluding Selected Articles</i>	62	4	6.5%	302	15	5.0%	1.5%	0.479	0.632

Notes:

[1] ***, **, * indicate statistical significance at the 10 percent, 5 percent, and 1 percent level, respectively. This analysis measures the difference between the percentage of “news” and “non-news” dates that are statistically significant, as Dr. Tabak performed. A z-statistic (also known as a z-score) represents the number of standard deviations that a specific value is from the population mean. The z-statistics and associated p-values shown measure the probability that this calculated difference, assuming the price movements on “news” and “non-news” dates were indistinguishable, could have occurred by chance. An absolute value of a z-statistic of 1.96 or higher would indicate statistical significance with at least 95 percent confidence and thereby would suggest that the Vale ADRs experienced statistically different price movements on “news” dates when compared to “non-news” dates.

[2] The “Earnings Dates,” “*Dow Jones Newswires - All sources*,” and “*Dow Jones Newswires - Excluding Selected Articles*” classifications for “news” dates and “non-news” dates during the Proposed Class Period are derived from Dr. Tabak’s fifth *Cammer* factor analysis presented in Exhibits 2, 8a1, 8a2, and 8d of the Tabak Report.

[3] I use Dr. Finnerty’s Modified Fama-French Three-Factor Model to conduct Dr. Tabak’s fifth *Cammer* factor analysis presented in the Tabak Report, Exhibits 8a1 and 8a2. Like Dr. Finnerty, I apply the market model to two sub-periods, with a breakpoint on May 12, 2015. Dr. Finnerty excludes the dates of the alleged misrepresentations and corrective disclosures from his regression analysis, and also excludes any dates that do not have a corresponding return for the Bovespa Index (one of Dr. Finnerty’s additional explanatory factors). I also exclude these dates from this analysis.

Sources:

Finnerty Report and Backup Materials; Tabak Report; S&P Capital IQ; Bloomberg.

Confidential

Exhibit 3B
Percentage of Dates with Statistically Significant Abnormal Returns on News Dates as Compared to Non-News Dates for NYSE VALE.P
Using Dr. Finnerty's Modified Fama-French Three-Factor Model
Proposed Class Period: May 8, 2014 to November 27, 2015

	News Dates			Non-News Dates			Difference in Percentages	z-Statistic	p-value
	Total Number	Number with Significant Excess Returns	Percentage of Dates with Significant Excess Returns	Total Number	Number with Significant Excess Returns	Percentage of Dates with Significant Excess Returns			
Earnings Dates	6	0	0.0%	358	18	5.0%	-5.0%	-0.563	0.573
<i>Dow Jones Newswires - All Sources</i>	116	8	6.9%	248	10	4.0%	2.9%	1.174	0.240
<i>Dow Jones Newswires - Excluding Selected Articles</i>	62	4	6.5%	302	14	4.6%	1.8%	0.601	0.548

Notes:

[1] ***, **, * indicate statistical significance at the 10 percent, 5 percent, and 1 percent level, respectively. This analysis measures the difference between the percentage of "news" and "non-news" dates that are statistically significant, as Dr. Tabak performed. A z-statistic (also known as a z-score) represents the number of standard deviations that a specific value is from the population mean. The z-statistics and associated p-values shown measure the probability that this calculated difference, assuming the price movements on "news" and "non-news" dates were indistinguishable, could have occurred by chance. An absolute value of a z-statistic of 1.96 or higher would indicate statistical significance with at least 95 percent confidence and thereby would suggest that the Vale ADRs experienced statistically different price movements on "news" dates when compared to "non-news" dates.

[2] The "Earnings Dates," "Dow Jones Newswires - All sources," and "Dow Jones Newswires - Excluding Selected Articles" classifications for "news" dates and "non-news" dates during the Proposed Class Period are derived from Dr. Tabak's fifth *Cammer* factor analysis presented in Exhibits 2, 8a1, 8a2, and 8d of the Tabak Report.

[3] I use Dr. Finnerty's Modified Fama-French Three-Factor Model to conduct Dr. Tabak's fifth *Cammer* factor analysis presented in the Tabak Report, Exhibits 8a1 and 8a2. Like Dr. Finnerty, I apply the market model to two sub-periods, with a breakpoint on May 12, 2015. Dr. Finnerty excludes the dates of the alleged misrepresentations and corrective disclosures from his regression analysis, and also excludes any dates that do not have a corresponding return for the Bovespa Index (one of Dr. Finnerty's additional explanatory factors). I also exclude these dates from this analysis.

Sources:

Finnerty Report and Backup Materials; Tabak Report; S&P Capital IQ; Bloomberg.

Appendix A
Curriculum Vitae

WALTER N. TOROUS

Massachusetts Institute of Technology

Office Address:

Massachusetts Institute of Technology
Building 9-332
77 Massachusetts Avenue
Cambridge, MA, 02139
Telephone: (Office) (617) 324-7027

E-Mail wtorous@mit.edu

Home Address

75 Cambridge Parkway, Unit E801
Cambridge, MA, 02142
Telephone: (310) 873-8325

Academic Degrees

B. Math. University of Waterloo, Statistics and Economics, 1976
Ph. D. University of Pennsylvania, Economics, 1981
Dissertation Title "Differential Taxation and the Equilibrium Structure of Interest Rates"
Supervisor: Robert J. Shiller
Awarded William Polk Carey Prize for Best Doctoral Dissertation

Academic Appointments

1980-81	Graduate School of Business Administration, University of Michigan, Lecturer
1981-85	Graduate School of Business Administration, University of Michigan, Assistant Professor
1986-87	Graduate School of Management, University of California, Los Angeles, Visiting Assistant Professor
1987-90	Graduate School of Management, University of California, Los Angeles, Assistant Professor

Confidential

1990-95 John E. Anderson Graduate School of Management, University of California, Los Angeles, Associate Professor

1995-97 London Business School, Corporation of London Professor of Finance

1995-2006 John E. Anderson Graduate School of Management, University of California, Los Angeles, Professor

1997-2003 Director, Richard S. Ziman Real Estate Center, John E. Anderson Graduate School of Management, University of California, Los Angeles

2006-2012 John E. Anderson Graduate School of Management, University of California, Los Angeles, Lee and Seymour Graff Endowed Professor

2009-2011 Visiting Professor
Center for Real Estate
Massachusetts Institute of Technology, Cambridge, MA

2012- Senior Lecturer
Center for Real Estate / Sloan School of Management
Massachusetts Institute of Technology, Cambridge, MA

Professional Activities

Journal of Housing Economics, Associate Editor, 1991 -
Journal of Real Estate Finance and Economics, Associate Editor, 1992 -
Real Estate Economics,
 Associate Editor, 1993 - 2005, 2015 -
 Editor, 2006 - 2014
Pacific-Basin Finance Journal, Associate Editor, 1997- 2003
Economic Notes, Associate Editor, 1999 - 2011

Ad hoc referee for Journal of Finance, Journal of Financial and Quantitative Analysis, Journal of Banking and Finance, Journal of Business, Review of Financial Studies, Journal of Financial Economics, Journal of Money, Credit, and Banking, Management Science, Journal of Empirical Finance, Journal of International Money and Finance

Member:

American Finance Association, 1980 -
 American Real Estate and Urban Economics Association, 1990 -
 Western Finance Association, 1980 -
 Associate Program Chair, 1990
 Board of Directors, 1991-94

Refereed Publications

1. Ball, C. A., and Torous, W. N., "A Simplified Jump Process for Common Stock Returns," Journal of Financial and Quantitative Analysis, 18:1, pp. 53-65, March 1983.
2. Ball, C. A., and Torous, W. N., "Bond Price Dynamics and Options," Journal of Financial and Quantitative Analysis, 18:4, pp. 517-531, December 1983.
3. Ball, C. A., and Torous, W. N., "The Maximum Likelihood Estimation of Security Price Volatility: Theory, Evidence, and Application to Option Pricing," Journal of Business, 57:1, pp. 97-112, January 1984.
4. Milne, W. J., and Torous, W. N., "Long-Term Interest Rates and the Price Level: The Canadian Evidence on the Gibson Paradox," Canadian Journal of Economics, 17:2, pp. 327-339, May 1984.
5. Ball, C. A., Torous, W. N., and Tschoegl, A. E., "On Inferring Standard Deviations from Path Dependent Options," Economic Letters, 18, pp. 377-380, 1985.
6. Ball, C. A., Torous, W. N., and Tschoegl, A. E., "The Degree of Price Resolution: The Case of the Gold Market," Journal of Futures Markets, 5:1, pp.29-43, Spring 1985.
7. Ball, C. A., Torous, W. N., and Tschoegl, A. E., "An Empirical Investigation of the EOE Gold Options Market," Journal of Banking and Finance, 9:1, pp. 101-113, March 1985.
8. Ball, C. A., and Torous, W. N., "On Jumps in Common Stock Prices and Their Impact on Call Option Pricing," Journal of Finance, 40:1, pp. 155-173, March 1985.
9. Torous, W. N., "Differential Taxation and the Equilibrium Structure of Interest Rates," Journal of Banking and Finance, 9, pp. 363-385, August 1985.

Reprinted in The Debt Market, S. Ross (Editor), Edward Elgar, 2000.

10. Ball, C. A., and Torous, W. N., "Futures Options and the Volatility of Futures Prices," Journal of Finance, 41:4, pp. 857-870, September 1986.
11. Ball, C. A., and Torous, W. N., "Investigating Security Price Performance in the Presence of Event Date Uncertainty," Journal of Financial Economics, 22, pp. 123-153, October 1988.
12. Schwartz, E. S., and Torous, W. N., "Prepayment and the Valuation of Mortgage-Backed Securities," Journal of Finance, 44:2, pp. 375-392, June 1989.
13. Titman, S., and Torous, W. N., "Valuing Commercial Mortgages: An Empirical Investigation of the Contingent-Claims Approach to Valuing Commercial Mortgages," Journal of Finance, 44:2, pp. 345-373, June 1989.

Reprinted in The Debt Market, S. Ross (Editor), Edward Elgar, 2000.

14. Franks, J. R., and Torous, W. N., "An Empirical Investigation of U.S. Firms in Reorganization," Journal of Finance, 44:3, pp. 747-769, July 1989.

Reprinted in Corporate Bankruptcy and Distressed Restructurings: Analytical Issues and Investment Opportunities, E. Altman (Editor), Irwin, 1992.

15. Schwartz, E. S., and Torous, W. N., "Valuing Stripped Mortgage-Backed Securities," Housing Finance Review, 8, pp. 241-251, Fall 1989.

Reprinted in The Debt Market, S. Ross (Editor), Edward Elgar, 2000.

16. Haugen, R. A., Talmor, E., and Torous, W. N., "The Effect of Volatility Changes on the Level of Stock Prices and Subsequent Expected Returns," Journal of Finance, 46:8, pp. 985-1007, July 1991.

17. Geske, R. L., and Torous, W. N., "Skewness, Kurtosis, and Black-Scholes Option Mispricing," Statistical Papers, 32, pp. 299-309, December 1991.

18. Schwartz, E. S., and Torous, W. N., "Prepayment, Default, and the Valuation of Mortgage Pass-Through Securities," Journal of Business, 65:2, pp. 221-239, April 1992.

19. Franks, J. R., and Torous, W. N., "Lessons from a Comparison of U.S. and U.K. Insolvency Codes," Oxford Review of Economic Policy, 8:3, pp. 70-82, September 1992.

Reprinted in Journal of Applied Corporate Finance, pp. 95-103, January 1993.

20. Schwartz, E. S., and Torous, W. N., "Mortgage Prepayment and Default Decisions: A Poisson Regression Approach", Journal of the American Real Estate and Urban Economics Association, 21:4, pp. 431-448, March 1993.

21. Franks, J. R., and Torous, W. N., "A Comparison of Financial Recontracting in Workouts and Chapter 11 Reorganizations," Journal of Financial Economics, 28:8, pp. 349-370, June 1994.

Reprinted in Studies in Empirical Corporate Finance, M. Brennan (Editor), Edward Elgar, 2001.

22. Ball, C. A., and Torous, W. N., "On Unit Roots and the Estimation of Interest Rate Dynamics", Journal of Empirical Finance, 3:2, pp. 215-238, June 1996.

23. Franks, J. R., Nyborg, K., and Torous, W. N., "A Comparison of U. K, U. S., and German Insolvency Codes," Financial Management, 25:3, pp. 274-301, Autumn 1996.

24. Roma, A., and Torous, W. N., "On the Cyclical Behavior of Interest Rates," Journal of Finance, 52:4, pp. 1519-1542, September 1997.

25. Brennan, M. J., and Torous, W. N., "Individual Decision Making and Investor Welfare," Economic Notes, 28:2, pp. 119-143, July 1999.

26. Ball, C. A., and Torous, W. N., "The Stochastic Volatility of Short-term Interest Rates: Some International Evidence," Journal of Finance, 54:6, pp. 2339-2359, December 1999.

Reprinted in Model Risk: Concepts, Calibration, and Pricing, R. Gibson (Editor), Risk Books, 2000.

27. Ball, C. A., and Torous, W. N., "Stochastic Correlation Across International Stock Markets," Journal of Empirical Finance, 7:3-4, pp. 373-388, November 2000.
 28. Torous, W. N., Yan, S. and Valkanov, R., "On Predicting Stock Returns with Nearly Integrated Explanatory Variables," Journal of Business, 77:4, pp. 937-966, October 2004.
 29. Dierker, M., Quan, D., and Torous, W. N., "Pricing the Defeasance Option in Securitized Commercial Mortgages," Real Estate Economics, 33:4, pp. 663-680, Winter 2005.
 30. Berardi, A., and Torous, W. N., "Term Structure Forecasts of Long Term Consumption Growth," Journal of Financial and Quantitative Analysis, 40:2, pp. 241-258, June 2005.
 31. Brennan, M. J., Lee, F., and Torous, W. N., "Dollar Cost Averaging", Review of Finance, 9:4, pp. 509-535, 2005.
 32. Hong, H, Torous, W. N., and Valkanov, R., "Do Industries Lead Stock Markets?", Journal of Financial Economics, 83:2, pp. 367-396, 2007.
 33. Schwartz, E. S., and Torous, W. N., "Commercial Office Space: Testing the Implications of Real Options Model with Competitive Interactions", Real Estate Economics, 35:1, pp. 1-20, 2007.
- Awarded Edwin S. Mills Prize for best paper in Real Estate Economics for 2007.
34. Plazzi, A., Torous, W. N., and Valkanov, R., "The Cross-Sectional Dispersion of Commercial Real Estate Returns and Rent Growth: Time Variation and Economic Fluctuations", Real Estate Economics, 36:3, pp. 403-429, 2008.
 35. Plazzi, A., Torous, W. N., and Valkanov, R., "Expected Returns and the Expected Growth in Rents of Commercial Real Estate", Review of Financial Studies, 23:9, pp. 3469-3519, 2010.
 36. Plazzi, A., Torous, W.N., and Valkanov, R., "Exploiting Property Characteristics in Commercial Real Estate Portfolio Allocation", Journal of Portfolio Management, Special Real Estate Issue, pp. 39-50, 2011.
 37. Linnainmaa, J. T., Torous, W. N., and Yae, J., "Reading the Tea Leaves: Model Uncertainty, Robust Forecasts and the Autocorrelation of Analysts' Forecast Errors" Journal of Financial Economics, 122:1, pp. 42-64, 2016.
 38. Ghent, A., Torous, W. N., and Valkanov, R., "Complexity in Structured Finance", Review of Economic Studies, 86:2, pp. 694-722, 2019.
 39. Ghent, A., Miltersen, K., and Torous, W. N., "Second Mortgages: Valuation and Implications for the Performance of Structured Financial Products", forthcoming, Real Estate Economics, 2019.

Chapters in Books

40. Geske, R. L., and Torous, W. N., "Black-Scholes Option Pricing and Robust Variance Estimation," pp. 49-69, in Options: Recent Advances in Theory and Practice, S. Hodges (Editor), Manchester University Press, 1990.

41. Schwartz, E. S., and Torous, W. N., "Caps on Adjustable Rate Mortgages: Valuation, Insurance, and Hedging," pp. 283-303, in Financial Markets and Financial Crises, R. G. Hubbard (Editor), University of Chicago Press, 1991.
42. Betker, B. L., Franks, J. R., and Torous, W. N., "Are Stockholders Better Off When Debt is Restructured Privately?", pp. 391-400, in Corporate Bankruptcy and Distressed Restructuring: Analytical Issues and Investment Opportunities, E. Altman (Editor), Irwin, 1992.
43. Torous, W. N., "Mortgage Backed Securities," in North-Holland Handbook of Operations Research and Management Science, R. A. Jarrow, V. Maksimovic, and W. T. Ziemba (Editors), North-Holland, 1995.
44. Franks, J. R., Nyborg, K., and Torous, W. N., "A Tale of Three Codes: A Comparison of U. K., U. S., and German Insolvency Codes," in Mastering Finance, H. Rose (Editor), Pittman Publishing, 1998.
45. Torous, W. N. "The Behaviour of Short Term Interest Rates," in Mastering Finance, H. Rose (Editor), Pittman Publishing, 1998.
46. Schwartz, E. S., and Torous, W. N., "Can We Disentangle Risk Aversion from Intertemporal Substitution in Consumption?", in Essays on Uncertainty: Festschrift in Honor of Steinar Ekern, Norges Handelshoyskole, Bergen, Norway, 2002.
47. Ghysels, E., Plazzi, A., Torous, W. N., and R. Valkanov, R., "Forecasting Real Estate Prices", in Handbook of Economic Forecasting, Volume 2A, G. Elliott and A. Timmermann (Editors), North-Holland, 2013.

Submitted Manuscripts

48. Agarwal, S., Liu, C., Torous, W. N., and Yao, V. W., "Household Financial Decision Making when Buying and Owning a Home", submitted, Journal of Money, Credit, and Banking, 2017.

Working Papers

49. Bokhari, S., Torous, W. N., and Wheaton, W., "Leverage in the Housing Boom and Bust", 2015.
50. Boudry, W., Liu, C., Mulhofer, T., and Torous, W.N., "Using Cash Flow Dynamics to Price Thinly Traded Assets", 2017.
51. Plazzi, J, and Torous, W.N., "Does Corporate Governance Matter? Evidence from the AGR Governance Rating", 2017.

Appendix B

WALTER N. TOROUS

List of Testimony and Expert Submissions in the Last Four Years

- 2019 – *In re American Realty Capital Properties, Inc. Litigation*, In the United States District Court for the Southern District of New York, Case no. 1:15-mc-00040-AKH.
Provided expert report and deposition testimony.
- 2019 – *Homeward Residential Inc. v. Sand Canyon Corp.*, In the United States District Court for the Southern District of New York, Case no. 1:17-cv-02097 (JFK/JLC).
Provided expert report.
- 2019 – *Megan Vilella, et al. v. Chemical and Mining Company of Chile Inc., et al*, In the United States District Court for the Southern District of New York, Case no. 1:15-cv-02106-ER_GWG.
Provided expert report in 2018 and rebuttal expert report in 2019.
- 2019 – *In re Sunedison, Inc. Securities Litigation*, In the United States District Court for the Southern District of New York, Case no. 1:16-MD-2742-PKC.
Provided expert report.
- 2018 – *Federal Home Loan Bank of Boston v. Ally Financial, Inc. F/K/A GMAC LLC, et al.*, In the United States District Court for the District of Massachusetts, Case No. 1:11-cv-10952-GAO
Provided expert report and deposition testimony.
- 2018 – *United States of America v. Quicken Loans Inc.*, In the United States District Court for the Eastern District of Michigan, Civil Action No. 16-14050-MAG-RSW
Provided expert report and deposition testimony.
- 2018 – *Gurbir S. Grewal, et al. v. Credit Suisse Securities (USA) LLC, et al.*, In the Superior Court of the State of New Jersey Chancery Division Mercer County, Civil Action No. MER-C-137-13
Provided expert report and deposition testimony.
- 2018 – *U.S. Bank National Association, solely in its capacity as Trustee of the CSMC Asset-Backed Trust 2007-NCI (CSMC 2007-NCI) v. DLJ Mortgage Capital, Inc.*, In the Supreme Court of the State of New York County of New York, Index No. 652699/2013
Provided expert report and deposition testimony.
- 2018 – *U.S. Bank National Association, solely in its capacity as Trustee of the Home Equity Asset Trust 2006-8 (HEAT 2006-8) v. DLJ Mortgage Capital, Inc.*, In the Supreme Court of the State of New York County of New York, Index No. 654157/2012
Provided expert report and deposition testimony.

Appendix B

- 2018 – *U.S. Bank National Association, solely in its capacity as Trustee of the Home Equity Asset Trust 2007-2 (HEAT 2007-2) v. DLJ Mortgage Capital, Inc.*, In the Supreme Court of the State of New York County of New York, Index No. 651174/2013
Provided expert report and deposition testimony.
- 2018 – *Residential Funding Company, LLC v. Home Loan Center, Inc.*, In the United States District Court for the District of Minnesota, Case No. 14-cv-01716 (SRN/HB)
Provided expert report and deposition testimony.
- 2018 – *Residential Funding Company, LLC v. Decision One Mortgage Company, LLC*, In the United States District Court for the District of Minnesota, Case No. 14-cv-1737 (MJD/JSM)
Provided expert report and deposition testimony.
- 2018 – *Residential Funding Company, LLC v. HSBC Mortgage Corp. (USA)*, In the United States Bankruptcy Court for the Southern District of New York, Case No. 14-01915 (MG)
Provided expert report and deposition testimony.
- 2018 – *Federal Deposit Insurance Corporation as Receiver for United Western Bank v. RBS Acceptance Inc., et al.*, In the United States District Court for the District of Colorado, Case No. 1:14-CV-00418-PAB-MJW
Provided expert report and deposition testimony.
- 2018 – *Federal Deposit Insurance Corporation as Receiver for Guaranty Bank v. Deutsche Bank Securities Inc., et al.*, In the United States District Court for the Western District of Texas Austin Division, Case No. 1:14-cv-00129-SS
Provided expert report and deposition testimony.
- 2018 – *Federal Deposit Insurance Corporation as Receiver for Guaranty Bank v. RBS Securities Inc., et al.*, In the United States District Court for the Western District of Texas Austin Division, Case No. 1:14-cv-00126-SS
Provided expert report and deposition testimony.
- 2017 – *In Re Vale S.A. Securities Litigation*, In the United States District Court for the Southern District of New York, No. 1:11-cv-09539-GHW
Provided expert report.
- 2017 – *Residential Funding Company, LLC v. Provident Funding Associates, L.P.*, In the United States District Court for the District of Minnesota, Case No. 13-cv-03485 (SRN/TNL)
Provided expert report.
- 2017 – *Ramon Moreno, et al. v. Deutsche Bank Americas Holding Corp., et al.*, In the United States District Court for the Southern District of New York, Case No. 1:15-cv-09936 (LGS)
Provided expert report and deposition testimony.

Appendix B

- 2017 – *Lou Baker, et al. v. SeaWorld Entertainment, Inc., et al.*, In the United States District Court for the Southern District of California, Case No. 3:14-cv-02129-MMA-AGS. Provided expert report and deposition testimony.
- 2017 – *Old Republic Insurance Company and Old Republic Insured Credit Services, Inc., n/k/a Republic Insured Credit Services, Inc. v. The Bank of New York Mellon, BNY Mellon Trust of Delaware, Countrywide Bank, FSB, n/k/a Bank of America, N.A., Countrywide Home Loans Servicing, LP, n/k/a Bank of America, N.A.; Countrywide Bank, FSB, n/k/a Bank of America, N.A., Countrywide Home Loans, Inc., Countrywide Home Loans Servicing, LP, n/k/a Bank of America, N.A., The Bank of New York Mellon, and BNY Mellon Trust of Delaware v. Old Republic Insurance Company*; In the Circuit Court of Cook County, Illinois for the County Department, Chancery Division, Case No. 08 CH 47501
Provided expert report and deposition testimony.
- 2017 – *Royal Park Investments SA/NV v. HSBC Bank USA, National Association*, In the United States District Court for the Southern District of New York, Case No. 14-CV-8175-LGS-SN; *BlackRock Balanced Capital Portfolio (FI), et al. v. HSBC Bank USA, National Association*, In the United States District Court for the Southern District of New York, Case No. 14-CV-9366-LGS-SN
Provided expert report and deposition testimony.
- 2017 – *Aleksandr Urakhchin, et al. v. Allianz Asset Management of America, L.P., et al.*, In the United States District Court for the Central District of California, Case No. 8:15-cv-01614-JVS-JCG
Provided expert report.
- 2017 – *U.S. Bank National Association, solely in its capacity as Trustee for Citigroup Mortgage Loan Trust 2007-AR7 v. Citigroup Global Markets Realty Corp. and CitiMortgage, Inc.*, In the United States District Court for the Southern District of New York, Civil Action No. 13 Civ. 6989 (GBD)
Provided expert report and deposition testimony.
- 2016 – *U.S. Bank National Association, solely in its capacity as Trustee of the Home Equity Asset Trust 2007-1 (HEAT 2007-1) v. DLJ Mortgage Capital, Inc.*, In the Supreme Court of the State of New York County of New York, Index No. 650369/2013
Provided expert report and deposition testimony.
- 2016 – *Federal Deposit Insurance Corporation v. Credit Suisse First Boston Mortgage Securities Corp., et al.*, In the Circuit Court of Montgomery County, Alabama, Civil Action No. 03-CV-2012-901035.00 and *Federal Deposit Insurance Corporation v. RBS Securities Inc.*, In the Circuit Court of Montgomery County, Alabama, Civil Action No. 03-CV-2012-901036.00
Provided expert report and deposition testimony.

Appendix B

- 2016 – *Home Equity Mortgage Trust Series 2006-1, et al. v. DLJ Mortgage Capital, Inc. and Select Portfolio Servicing, Inc.*, In the Supreme Court of the State of New York, County of New York, Index No. 156016; *Home Equity Mortgage Trust Series 2006-5, by U.S. Bank National Association, solely in its capacity as Trustee v. DLJ Mortgage Capital, Inc. and Select Portfolio Servicing, Inc.*, In the Supreme Court of the State of New York, County of New York, Index No. 653787
Provided expert report and deposition testimony.
- 2016 – *Federal Home Loan Bank of San Francisco v. Deutsche Bank Securities Inc., et al.*, In the Superior Court of the State of California and for the City and County of San Francisco, Case No. CGC-10-497840
Provided expert report.
- 2016 – *Federal Deposit Insurance Corporation v. RBS Securities Inc.*, In the Circuit Court of Montgomery County, Alabama, Civil Action No. 03-CV-2012-901036.00
Provided expert report and deposition testimony.
- 2016 – *Federal Deposit Insurance Corporation v. Credit Suisse First Boston Mortgage Securities Corp., et al.*, In the Circuit Court of Montgomery County, Alabama, Civil Action No. 03-CV-2012-901035.00
Provided expert report.
- 2016 – *National Credit Union Administration Board v. RBS Securities Inc., et al.*, In the United States District Court for the Central District of California, Case No. 11-cv-5887 GW (JEM)
Provided expert report and deposition testimony.
- 2016 – *National Credit Union Administration Board v. RBS Securities Inc., et al.*, In the United States District Court for the District of Kansas, Case No. 11-cv-2340 JWL (JPO)
Provided expert report and deposition testimony.
- 2016 – *Federal Home Loan Bank of San Francisco v. Deutsche Bank Securities Inc., et al.*, In the Superior Court of the State of California and for the City and County of San Francisco, Case No. CGC-10-497839
Provided expert report and deposition testimony.
- 2016 – *Federal Housing Finance Agency v. The Royal Bank of Scotland Group PLC, et al.*, In the United States District Court of Connecticut, Case No. 3:11-CV-01383 (AWT)
Provided expert report and deposition testimony.
- 2016 – *SACO I Trust 2006-5, issuer of the SACO I Trust 2006-5 Mortgage-Backed Certificates, Series 2006-5, et al. v. EMC Mortgage LLC, et al.*, In the Supreme Court of the State of New York for the County of New York, Case No. 651820/2012
Provided expert report.

Appendix B

- 2015 – *L.J. Gibson, et al. v. Credit Suisse AG, et al.*, In the United States District Court for the District of Idaho, Case No. 1:10-cv-00001-JLQ
Provided expert report.
- 2015 – *Deutsche Bank National Trust Company, as Trustee for Morgan Stanley ABS Capital I Inc. Trust 2007-HE6 v. Decision One Mortgage Company, LLC*, In the Circuit Court of Cook County, Illinois for the County Department, Law Division, Case No. 2013 L 005823
Provided expert report and deposition testimony.
- 2015 – *Federal Home Loan Bank of San Francisco v. Deutsche Bank Securities, et al.*, and *Federal Home Loan of San Francisco v. Credit Suisse Securities (USA) LLC, et al.*, In the Superior Court of the State of California and for the City and County of San Francisco, CGC-10-497839 and CGC-10-497840
Provided expert report.
- 2015 – *New Jersey Carpenters Health Fund, on Behalf of Itself and All Others Similarly Situated v. Novastar Mortgage, Inc., et al.*, In the United States District Court for the Southern District of New York, Case No. 08-CV-5310 (DAB)
Provided expert report and deposition testimony.
- 2015 – *In Re MF Global Holdings Limited Securities Litigation*, In the United States District Court for the Southern District of New York, Case No. 1:11-cv-07866-VM
Provided expert report and deposition testimony.
- 2015 – *Federal Home Loan Bank of Seattle, a bank created by federal law v. Deutsche Bank Securities Inc., a Delaware corporation; Deutsche Alt-A Securities, Inc., a Delaware corporation; and DB Structured Products, Inc., a Delaware corporation*, In the Superior Court of Washington for King County, Case No. 09-2-46351-4 SEA
Provided expert report and deposition testimony.
- 2015 – *Federal Home Loan Bank of Seattle, a bank created by federal law v. RBS Securities Inc., f/k/a/ Greenwich Capital Markets, Inc., a Delaware Corporation; Greenwich Capital Acceptance, Inc., a Delaware Corporation; and RBS Holdings USA, Inc., f/k/a Greenwich Capital Holdings, Inc., a Delaware Corporation*, In the Superior Court of Washington for King County, Case No. 09-2-46347-6
Provided expert report and deposition testimony.
- 2015 – *Fort Worth Employees' Retirement Fund, On Behalf of Itself and All Others Similarly Situated v. J.P. Morgan Chase & Co., et al.*, In the United States District Court for the Southern District of New York, Case No. 1:09-cv-03701 (JPO)
Provided expert report and deposition testimony.

Appendix C

Documents Relied Upon

Legal Filings

In re: Vale S.A. Securities Litigation Consolidated Amended Class Action Complaint, April 29, 2016.

In re: Vale S.A. Securities Litigation, Memorandum Opinion and Order, March 23, 2017.

In re: Vale S.A. Securities Litigation, Order, May 26, 2017.

Expert Reports and Depositions

Deposition of David I. Tabak, October 26, 2017.

Expert Report of David I. Tabak, Ph.D., September 14, 2017.

Expert Report of John D. Finnerty, Ph.D., July 19, 2019 (and all associated supporting materials).

Rebuttal Expert Report of Walter N. Torous, Ph.D., November 3, 2017.

Academic Papers & Books

Clifford Ball and Walter Torous, “Investigating Security-Price Performance in the Presence of Event-Date Uncertainty,” *Journal of Financial Economics*, Vol. 22 (April 1988), pp. 123–153.

Eugene F. Fama and Kenneth R. French, “Common risk factors in the returns on stocks and bonds,” *Journal of Financial Economics*, Vol. 33 (1993), pp. 3–56.

James H. Stock and Mark W. Watson, *Introduction to Econometrics*, Addison Wesley (2003).

Paul Newbold, et al., *Statistics for Business and Economics*, 8th Edition, Pearsons (2012).

Robert G. Bowman, “Understanding and Conducting Event Studies,” *Journal of Business Finance & Accounting*, 10–4 (1983).

Public Filings

US Securities and Exchange Commission, Form 20-F for Vale S.A., December 31, 2016.

Analyst Reports

Morningstar Equity Research, “Vale SA, Vale’s low costs and ample growth prospects partly offset waning Chinese iron ore appetite,” May 1, 2014.

Scotiabank, “Vale SA, Nickel Optimism or Iron Ore Realism?” May 16, 2014.

J.P.Morgan, “Vale – Weak Commodity Price Outlook to Keep Pressure on FCF; Stay Neutral,” June 29, 2015.

Credit Suisse, “Vale,” November 23, 2015.

Morningstar Equity Research, “Vale SA, Vale generates profits even given the decline in iron ore prices, due to its low-cost production,” November 24, 2015.

Appendix C
Documents Relied Upon

Web Sources

“Bovespa Index (Ibovespa),” B3, available at: http://www.b3.com.br/en_us/market-data-and-indices/indices/broad-indices/ibovespa.htm.

Vale, Iron Ore Indices, available at: <http://www.vale.com/EN/business/mining/iron-ore-pellets/Pages/Iron-Ore-Indices.aspx>.

VALE3, Bloomberg, available at: <https://www.bloomberg.com/quote/VALE3:BZ>.

Data

Bloomberg.

Thomson One.

S&P Capital IQ.